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Two new blue species of *Entoloma* (*Basidiomycetes, Agaricales*) from South China

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Abstract — Two new species of *Entoloma* are described. *E. subaltissimum* is characterized by its blue pileus, distant to subdistant lamellae, quadrate basidiospores and broadly clavate cheilocystidia; and *E. dinghuense* by the blue pileus, 5–6-angled basidiospores and subvesicular or subclavate pleurocystidia.

Key words — *Entolomataceae*, taxonomy

Introduction

At least 132 species of *Entolomataceae* have been recorded in China (Li et al. 2008), with over 600 *Entoloma* collections being deposited in various herbaria. About one third of these originate from South China, an area of tropical and subtropical climate; another third from Southwest China with tropical monsoon climate and various mountain plateau climates; and the remaining from various low temperature climatic zones elsewhere in China. When studying the specimens for compiling a Flora Fungorum Sinicorum on *Entolomataceae*, 24 collections from South China characterised by a blue pileus were re-examined by the authors. Two collections were found possessing characters distinct from those found in any previously described taxa and are herein formally recognized. The holotypes are deposited in the Herbarium of Guangdong Institute of Microbiology (GDGM).

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Materials and methods

Specimens were annotated in the field, and dried in an electric drier, then deposited in the herbarium. Tissues were mounted in 5% potassium hydroxide solution (KOH) and 10% ammonia (NH_4OH) for microscopic examination. Dimensions of basidiospores (excluding the apiculus), basidia (excluding the sterigmata), cystidia (if present) and hyphal diameter are given with *(a–)b–c(–d)*. The range *b–c* contains the mean value of 20–30 objects measured. Extreme values *a* and *d* are given in parentheses, where appropriate. Photographs of microscopic characters were taken with a trinocular phase contrast microscope with light optics (Nikon Eclipse 80i), and an image was taken under a scanning electron microscope (Philips FEI-XL30). Colour designations within parentheses followed Kornerup & Wanscher (1978).

Taxonomy

Entoloma subaltissimum T.H. Li & Chuan H. Li, **sp. nov.** Figs.1–6

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Pileus 20–35 mm latus, conicus, hemisphericus vel convexus, lazulinus, maculis fulvis quum tactu, furfuraceus, leviter striatus. Lamellae fere liberae vel adnexae, dilute lazulinae, 2–3.5 mm latae, distantes vel subdistantes. Stipes 50–80 × 2–3 mm, cylindraceus, concolor cum pileo. Basidiosporae 8.5–12.5 × 8–12 µm, subquadratae vel quadratae. Basidia 27–50 × 10–15 µm, clavata, 2–4-sporigera, fibulata. Cheilocystidia 50–76 × 15–29 µm, clavata. Pleurocystidia desunt. Pileipellis ex hyphis 4–15.5 µm crassis, repentibusis. Pileipellis et stipitipellis hyphis fibulatis. Pileocystidia et caulocystidia desunt.

Holotype: China, Hainan Province, Ledong County, Jianfengling National Nature Reserve, alt. 900 m, 28 December 1987, T.H. Li GDGM **holotype** 12490.

Etymology: named based on morphological similarities shared with a previously named species, *Entoloma altissimum*.

Basidiomata small-sized, mycenoid, mostly blue with some rusty yellow (2A3–3A3) maculae on pileus, stipe and lamellae where bruised or drying. Pileus 20–35 mm broad, conical to hemispherical, papillate or not when young, becoming convex with age, denticulate or crenate at margin, glabrous to weakly furfuraceous, hygrophanous, slightly striate, deep blue (22A4–23A4), pale turquoise or light green (24A3–25A4), turquoise grey to greenish green (24B2–25B2), sometimes pale blue (22A3–23A3) near margin. Lamellae 2–3.5 mm broad, subfree to adnexed, distant to subdistant, ventricose, light blue (22A5–23A5), tinted with pink, lamellulae present; lamellar edge entire. Stipe central, 50–80 mm long, 2–3 mm thick at apex, cylindrical, slightly enlarged downwards, concolorous with pileus or paler, usually pale blue (22A3–23A3) to light blue (22A5–23A5) at apex and near base, glabrous, hollow. Context thin, light blue (22A5–23A5) to pale green (25A3). Taste peppery.

Figs. 1–6: *Entoloma subaltissimum* (GDGM 12490).
1. Basidiomata. 2. Basidiospores. 3. Basidiospores under SEM (untreated with OsO_4).
4. Cheilocystidia. 5. Clamp connection in pileipellis. 6. Radial section of pileus.
Bars: 1= 2 cm; 2, 5= 10 µm; 3, 4 and 6= 20 µm

Basidiospores 8.0–12.5 × 8–12 µm, subquadrate to quadrate, cuboid under scanning electron microscope, with obvious apiculus, smooth, pinkish. Basidia 27–50 × 10–15 µm, clavate, 2–4-spored, with sterigmata 2.5–5 µm long, clamped at base, with yellow-brown pigment in KOH. Cheilocystidia 50–76 × 15–29 µm, broadly clavate, with yellow-brown vacuolar pigment in KOH. Pleurocystidia absent. Lamellar trama hyphae subparallel,

10–34 μm broad, cylindrical to inflated, thin-walled, hyaline. Pileipellis a cutis composed of repent hyphae 4–15.5 μm broad, with blue intracellular pigment in suprapellis and brown cytoplasmic pigment in hypodermal hyphae in NH_4OH or KOH. Stipitipellis a cutis composed of subparallel hyphae, with blue intracellular pigment in suprapellis in NH_4OH. Pileocystidia and caulocystidia absent. Clamp connections present in all tissues.

Habit, habitat and distribution: Scattered on soil in a broadleaf forest; known only from the type locality.

Commentary: *E. subaltissimum* is a member of section *Staurospora* (Noordeloos 1981, Singer 1986). The new species is characterized by its blue basidiomata, usually with rusty yellow maculae on pileus, stipe and lamellae where bruised or drying, peppery taste, quadrate basidiospores, and broadly clavate cheilocystidia with yellow-brown vacuolar pigment.

At least 107 species of *Entoloma* with a blue pileus have been formally described, but blue-capped species in section *Staurospora* is until now rare. Two Asian species, *E. altissimum* (Massee) E. Horak originally described from Singapore and *E. virescens* (Berk. & M.A. Curtis) E. Horak ex Courtec. from Bonin Islands of Japan, and an Oceanian species, *E. hochstetteri* (Reichardt) G. Stev. from New Zealand, are similar to the new species in those aspects. Nevertheless, these species have their own distinctive characters: *E. altissimum* has a non-striate, fibrillose pileus, crowded lamellae, smaller basidiospores (7–10.5 μm), and longer but narrower, cylindrical to clavate cheilocystidia with brown plasmatic pigment (50–130 × 6–20 μm) (Horak 1975); *E. virescens* has closer lamellae, fusoid to cylindrical pseudocystidia and lactiferae, and lacks cheilocystidia (Courtecuisse 1986); and *E. hochstetteri* has larger basidiospores (11–15 × 11–14 μm), fusoid and thinner cheilocystidia (40–60 × 8–14 μm) (Stevenson 1962, Horak 1973). *E. azureoviride* E. Horak & Singer from Brazil, South America also has a blue pileus and cuboid basidiospores, but it has close to crowded lamellae and smaller basidiospores (5–8.5 μm) (Horak 1982). Microscopically, there are also many species of *Entoloma* with quadrate or cuboid basidiospores, especially in southeastern and southern Asia (Horak 1975, 1980; Manimohan 1995, 2006), but those, apart from the species mentioned above, do not have a blue pileus.

Macroscopically, the following additional species could be confused with *E. subaltissimum* for their similar blue colour and size of basidiomata, but they can easily be distinguished in microscopic characters: both *E. rugosopruinatum* (reported from Sabah, Malaysia) and *E. strictum* (from New Zealand) have 5–6-angled basidiospores and lack cystidia (Stevenson 1962; Horak 1973, 1980); *E. nitidum* from Europe has 6–8-angled basidiospores and lacks cystidia (Noordeloos 1981, 1987); *E. euchroum* from Europe has 5–7-angled

basidiospores and smaller cheilocystidia (22–50 × 5–15 µm) (Noordeloos 1987); and *Leptonia decolorans* f. *atropruinosipes* from North America has 5–6-angled basidiospores and narrower cheilocystidia (33.1–84.7 × 5.4–9.4 µm) (Largent 1994).

Entoloma dinghuense T.H. Li & Chuan H. Li, **sp. nov.** Figs. 7–11

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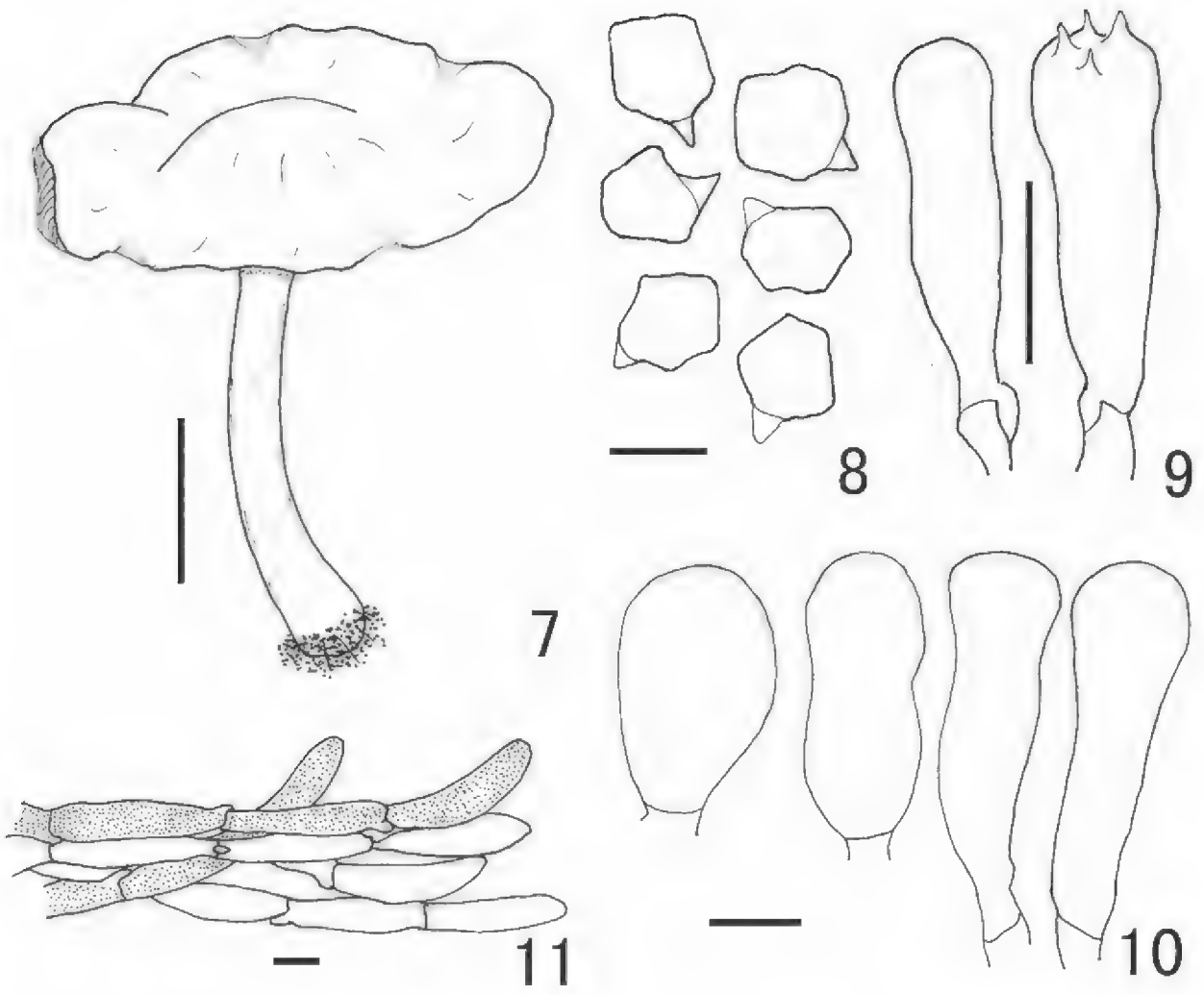
Pileus 70 mm latus, convexus vel planus, estriatus, lazulinus. Lamellae adnexae, distantes vel subdistantes. Stipes 60 × 6 mm, cylindraceus. Basidiosporae 8–11.5 × (6–)7.5–8.5(–10) µm, 5–6-angulatae. Basidia 38.5–41 × 9.5–14.5 µm, clavata, 2–4(–6)-sporigera, fibulata. Pleurocystidia 45–69 × 24–33.5 µm, subglobosa vel cylindraceo-clavata. Pileipellis ex hyphis 4–10.5(–15.5) µm crassis, repentis. Pileipellis et stipitipellis hyphis fibulatis. Pileocystidia et caulocystidia desunt.

Holotype: China, Guangdong Province, Dinghushan Biosphere Reserve, alt. 100 m, 24 May 1987, Z.S. Bi & T.H. Li GDGM **holotype** 11782.

Etymology: named in honor of the type locality, Dinghushan Biosphere Reserve.

Basidiomata medium-sized, collybioid. Pileus 70 mm broad, convex to plane with broad umbo, smooth, not viscid, estriate, slightly uplifted at margin with age, light blue to pale blue (22A5–23A3), greenish blue (28E2–30E2) when dry. Lamellae 5–7 mm broad, adnexed, distant to subdistant, lamellulae present, white when young, pinkish to pink with age; margin entire. Stipe 60 mm long, 6 mm thick at apex, central, cylindrical, slightly enlarged towards base, concolorous with pileus or paler, pale blue (22A3–23A3) at apex, becoming deeper blue downwards, light blue to pale blue (22A5–23A3) near base, glabrous, solid. Pileal context 3 mm thick at stipe, thin, white. Taste and smell mild.

Basidiospores 8–11.5 × (6–)7.5–8.5(–10) µm, isodiametric to subisodiametric, 5–6-angled in side-view, with obvious apiculus, pinkish. Basidia 38.5–41 × 9.5–14.5 µm, clavate, sometimes with many oil droplets, 2–4(–6)-spored, mostly 4-spored, but occasionally 6-spored, with sterigmata 1.5–5 µm long, clamped, hyaline in KOH. Pleurocystidia 45–69 × 24–33.5 µm, subvesicular, cylindrical-clavate to broadly clavate, sometimes with blunt tip, brownish in KOH. Cheilocystidia absent. Lamellar trama hyphae subparallel, 5–19.5 µm broad, cylindrical to inflated, thin-walled, colourless and hyaline. Pileipellis a cutis composed of repent hyphae 4.5–10.5(–15.5) µm broad, with slightly ascending terminal elements, thin-walled, with greenish blue intracellular pigment in suprapellis in NH_4OH, brownish cytoplasmic pigment in hypodermic hyphae in NH_4OH or KOH. Stipitipellis hyphae subparallel, 3.5–17 µm broad, with greenish blue-brown intracellular pigment in suprapellis in NH_4OH. Pileocystidia and caulocystidia absent. Clamp connections present in all tissues.



Figs. 7–11: *Entoloma dinghuense* (GDGM 11782).
7. Basidioma. 8. Basidiospores. 9. Basidia. 10. Pleurocystidia. 11. Pileipellis.
Bars: 7= 2 cm; 8 and 11= 10 μm; 9 and 10= 20 μm

Habit, habitat and distribution: Solitary on soil in a mixed forest; known only from the type locality.

Commentary: *E. dinghuense* is characterized by its combination of medium-sized collybioid basidiomata, a blue pileus, adnexed and distant to subdistant lamellae, isodiametric to subisodiametric basidiospores, clamped basidia and subvesicular, cylindrical-clavate to broadly clavate pleurocystidia. It should be placed in section *Rhodopolia* of subgenus *Entoloma* (Noordeloos 1981), but no blue-capped species under section *Rhodopolia* has been reported until now. In subgenus *Entoloma*, the new species may be confused with *E. coeruleomagnum* G.M. Gates & Noordel. originally reported from Tasmania, Australia in the blue pileus and 5–6-angled basidiospores. However, *E. coeruleomagnum* has a tricholomatoid basidioma, a large pileus, caulocystidia, a palisadoderm of erect hyphae in the pileipellis, and lacks hymenophoral cystidia (Gates & Noordeloos 2007).

Three other species with a medium-sized blue pileus and 5–6-angled basidiospores should also be compared with the new species. Two of them, *Rhodophyllus callidermus* Romagn. (from Congo) and *E. griseolazulinum* Manim. & Noordel. (from India) belong to section *Calliderma* of subgenus *Inocephalus*. *R. callidermus* lacks hymenophoral cystidia and clamp connections (Romagnesi 1957); *E. griseolazulinum* has a greyish blue pileus, free, crowded lamellae, and heterodiametrical basidiospores (Manimohan 2006). A third species, *E. viiduense* Noordel. & Liiv from Estonia, which belongs to section *Cyanula* of subgenus *Leptonia*, has a depressed to umbilicate pileus, 5–7(–8)-angled basidiospores and lacks hymenophoral cystidia (Noordeloos 1992).

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